

*Eastern Long Island species*

COLLECTED AUG. 18, 1900

*Lestes disjuncta*. Bridgehampton*Enallagma doubledayi*. Bridgehampton*Enallagma aspersum*. Bridgehampton*Enallagma durum*. Near Mecox bay (abundant; in cop.)*Enallagma civile*. Near Mecox bay (abundant; in cop.)*Ischnura verticalis*. Near Mecox bay and Bridgehampton*Anax junius*. Near Mecox bay and Bridgehampton*Plathemis lydia* (trimaculata). Bridgehampton*Libellula pulchella*. Bridgehampton*Tamea carolina*. Bridgehampton*Mesothemis simplicicollis*. Bridgehampton

Near Mecox bay, where I found the two species of *Enallagma* above recorded were many individuals of the spider, *Epeira stellata* Hentz, whose orblike webs, 4 to 6 inches in diameter, were stretched between the stalks of sedges and of grasses. Within a distance of not more than  $\frac{1}{10}$  mile along the pond's edge, I found six individuals of *Enallagma* in the spiders' webs. The dragon flies were all fully colored, were more or less enshrouded in silk, and some of them were partly eaten. In one and the same web were two *Enallagmas*.

*Part 4*

## SOME NEW LIFE HISTORIES OF DIPTERA

BY JAMES G. NEEDHAM

During the second season of our station the work done on Diptera was chiefly done on the families Chironomidae, Culicidae, Simuliidae, and Blepharoceridae, and is reported on by Mr Johannsen in part 6. But, in the course of routine operations, a few other very interesting new forms were come on, and four of these will be described in the following pages. Two of these, *Tipula flavicans* and *Epiphragma fascipennis*, were bred, and two were found only in the larval stage. These larvae, however, are so unique and interesting as to warrant their description at once; one clearly

belongs to the family Tipulidae; the other to the family Leptidae.

**Tipula flavicans Fabricius**

1805 *Tipula flavescens* (*in erratis, flavicans*) Fabricius, Syst. Antliatorum, p.24

1821 *Tipula flavicans* Wiedemann, Diptera Exotica. 1:25

1828 *Tipula flavicans* Wiedemann, Aussereur. zweiflüg. Insecten, 1:48

1878 *Tipula flavicans* Osten Sacken, Cat. Dipt. N. Am. p.38 (listed)

This common crane fly is widely distributed over the eastern United States and Canada. It belongs to the New York fauna, but I bred it from pupae collected at Lake Forest Ill. The pupae were found in a peculiar and very restricted habitat. In the bottom of a glacial pothole on the top of a small moraine there was a deep bottom layer of mud, muck and humus, nearly dry from the summer's evaporation, and perforated by a few crawfish holes, around whose mouths were little hillocks of clay, brought up by the crawfishes from a deeper stratum. In these clay hillocks, and only in these, I found the pupae, placed vertically in cylindric cavities, their heads almost reaching the upper surface of the clay. I collected a number of the pupae on Sep. 22, and the imagos began to emerge on the 23d and were all out on the 27th. During this time the adult flies were common among the bushes all about the pothole. They were not so easy to catch as are most crane flies; they readily took flight on the approach of a net, and, if pursued, would take refuge high up in the branches of neighboring trees, well out of reach.

**Pupa** [pl.10, fig.3]. Length 26mm, abdomen 20mm, respiratory horns 1.3mm; greatest diameter of the thorax 4mm, of abdomen 3mm.

Body cylindric, tapering at ends on the head and from the eighth abdominal segment, the abdomen with parallel sides, the thorax thickened toward its middle. Colors (generally obscured by adherent dirt) brown, paler on wings and legs, on lateral margins of abdomen and on two broad dorsal and two ventral areas nearly covering each abdominal segment.

Head unarmed; rostral sheath and base of antennal sheaths transversely corrugated. Antennae curving posteriorly around

the eyes and ending at the middle of the thorax on its ventral side. Palpi ending in a J-shaped hook.

Respiratory horns cylindric, becoming laterally flattened at tip, erect but bent anteriorly in their distal third. Wings and legs closely covering the ventral surface; tips of the wing cases reaching the base of the fourth abdominal segment; legs much curved beneath the wing cases; tarsi laid straight along the ventral side of the abdomen, those of the fore legs reaching the constriction of the middle of the fourth, those of the middle and hind legs, the apical circlet of spines on the fourth abdominal segment. Thorax unarmed; a low carina between the respiratory horns, ending posteriorly in a series of transverse corrugations, on either side of which are spots and lines of darker color.

Abdominal segments transversely divided by a constriction, both before and behind which, dorsally and ventrally, is a broad pale area bordered by darker brown, forming at the sides a band which includes the row of spiracles at the anterior border of segments 1-7. In the pale band on the lateral margin there arises a stout spine in the basal half and a larger one in the apical half of segments 2-7; here are also numerous brown dashes, merging into the larger, phalerate markings already described.

On the dorsal side in the apical half of each of segments 1-7 there is a transverse row of about a dozen sharp, minute thorns, very minute on 2, but becoming larger posteriorly; on the ventral side of same is a similar row of stouter thorns, becoming much stouter and fewer and nearer the hind margin posteriorly, while before them, near the middle constriction, stand an isolated pair of similar size. On segment 8 there are three pairs of stout spines on the dorsum, the intermediate pair being the largest, and there are three lesser pairs on the venter. On the end of the abdomen, and perhaps belonging to a ninth segment, there are two other pairs of spines, a larger yellowish, brown tipped, straight pair, and a smaller, terminal, upcurved pair.

### *Epiphragma fascipennis* Say

Plates 8, 9

*Limnobia fascipennis* Say, Acad. Nat. Sci. Phila. Proc. 3:19, 11:823

1828 *Limnobia fascipennis* Wiedemann, Aussereur. zweiflüg. Insecten, 1:31

1859 *Epiphragma pavonina* Osten Sacken, Acad. Nat. Sci. Phila. Proc. p.239

1869 *Epiphragma fascipennis* Osten Sacken, Mongr. N. Am. Dipt. 4:194

This beautiful crane fly [pl.8], which Osten Sacken attributes to the Atlantic states and Quebec, I have been trying to rear for several years at my home in Lake Forest; and I succeeded in the spring of 1901, and am now able to describe both larval and pupal stages.

The larvae bore in the dead and fallen stems of buttonbush and willow, where these lie on the mud at the borders of shallow ponds. I found them always in stems that were still partially sound, tunneling beneath the bark or even into the deeper parts and into the sounder wood. These stems are frequently submerged in spring and autumn, and even in summer, when the pond has gone dry, they are always saturated with moisture. The first two seasons that I tried to rear the larvae indoors I failed, because I could not keep their surroundings at the proper degree of moisture. In the spring of 1901 I placed the stems or pieces of the stems containing the larvae in the bottom of a big glass jar, hung a large sponge saturated with water in it, and laid on a loose cover, and with this apparatus I reared them, every one. Larvae and pupae were collected for rearing on May 18; imagos appeared on May 30. No imagos were seen at large, notwithstanding they were carefully looked for several times after they began to appear in the breeding jar.

The most interesting thing about the larva, aside from its wood-boring habits, is its singular adaptation to amphibian life. It must needs live part of the time wholly submerged beneath the waters of the pond, and part of the time out on land; it has, therefore, both open spiracles and tracheal gills; and, moreover, its tracheal gills are so placed that they may be withdrawn into the body in a dry time, where they escape the ills of too rapid evaporation. The spiracles are the two usual large ones on the terminal respiratory disk, common to all tipulidae. If a larva be taken from the stems and allowed to crawl on the hand, these will be the only respiratory apparatus visible; no fleshy anal processes, such as are common in the family, will be seen. The anal aperture will appear as a narrow longitudinal slit between two opercular flaps. But, if the same larva be

placed in a watch glass of water, these flaps will be seen to be separated, and there will be protruded between them four curved triangular, delicate, whitish, elongate gills, showing in their interior both tracheae and blood currents. These are doubtless respiratory appendages of the terminal portion of the walls of the rectum. A similar eversible condition of this part, with a much less perfect development of the gills themselves, has recently been described by Pantel in the *Bulletin de la Société entomologique de France*, 1901, page 59-61, for a Tachinid larva. The eversible portion of the rectum Pantel calls the anal vesicle, and to it he very properly attributes a respiratory function.

These four gills in *Epiphragma* are comparable to the four anal processes of the larva next to be described, and shown on plate 10, fig. 4, even to the constriction forming an apparent segment near the tip. They are comparable and homologous doubtless with the anal processes of other Tipulidae. There, however, they are permanently on the outside of the body, being no longer retractile. The end of the rectum has become permanently everted in these more aquatic larvae. The larva of *Epiphragma* is therefore specially interesting as showing what has been the course of development of this part of the very curious caudal armature of the typical Tipulid larvae.<sup>1</sup>

**Larva** [pl.9, fig.1]. Length 19mm; greatest diameter (base of thorax) 1.5mm. Cylindric, white, or faintly tinged with yellowish, with translucent sides and a brown head capsule. Head large, for the family, with pale antennae and labrum and stout blackish mandibles and labium. On the ventral side of each of the three thoracic segments is a pair of minute brownish points—vestiges

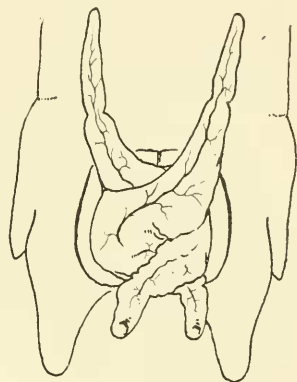


Fig. 18 Anal gills of the larva of *Epiphragma fascipennis*

<sup>1</sup> Elsewhere (*American Naturalist*, 36:185) I have pointed out, in a description of the larva of *Bibio fraternus*, that the segmental tubercles have offered the material out of which have been formed the other fleshy tubercles which surround the caudal respiratory disk.

of the larval legs. On the ventral side of abdominal segments 2-7 there is a single median proleg—a mere soft, white, transversely placed ridge, without hooks or claws. The abdomen is without other tubercles, spines or hairs. On the posterior end of the scarcely narrowed abdomen is a broad, white respiratory disk, with the two usual spiracles [pl.9, fig.2], large, distant, black, bordered with golden yellow in life. There are four thick processes at the border of the disk, of which the upper two are set apart the full width of the disk, have very blunt apexes and are pubescent externally, while the lower two are a little more pointed and a little closer together.

The anal aperture is closed by two operclelike plates, which open to allow the protrusion of the four delicate, white, elongate, curved, triangular anal processes (gills).

**Pupa** [pl.9, fig.3]. Length 12mm, horns almost 2mm additional; diameter 1.5mm. Color clear yellowish white at first, darkening with age, and showing before transformation the adult color pattern through the transparent skin; surfaces shining, nearly smooth. Head and face directed ventrally, with a pair of short, sharp pointed, stout, ventrally directed, divergent frontal spines.

The hypertrophied and functionless respiratory horns are large, long and stout, abruptly bent forward in their cylindric middle portion, beyond their short erect bases, and convergent at their tapering tips. They are very suggestive of cow horns in their shape, and a crumpled horn on one side is of rather common occurrence. The antennae curve dorsally around the eyes and knees and disappear beneath the wings. Legs laid flat against the ventral surface, the tips of the tarsi all ending near the apex of the fourth abdominal segment; wing tips reaching only to the level of the carina on the second abdominal segment.

Abdomen with sides parallel as far as the eighth segment; the apical carina on each segment is fringed with short, stiff hairs (on the ventral side of the eighth segment, more comb-like, and interrupted on the median line in the female). The rudiments of the four discal processes and the atrophied spiracles are plainly seen on the dorsum of the eighth segment.

Beling found the larvae of the European *Epiphragma picta* abundant in the rotting stems of ash and beech in the spring, transforming in May after a pupal period of about two weeks. He has described<sup>1</sup> a very unusual sexual differentiation in the larvae. The respiratory disk was said to be surrounded by five processes arranged in a pentagon in the male, by three

<sup>1</sup>Beling. Th. zur Naturgeschichte verschiedener Arten der Tipuliden. Verh. zool.-bot. Ges. in Wien. 1873. 23:590.



processes arranged in a triangle in the female larva. There is no such differentiation in *E. fascipennis*; the processes are four, and alike in the two sexes. Possibly Beling had the larvae of two species.

#### An unknown Tipulid larva from a spring

On plate 10, figures 4 and 5 we present a figure of a Tipulid larva of very unusual form. A few specimens were obtained July 19, 1901, from a small, cold spring brook near Fall creek, between Ithaca and Varna N. Y. The brook was filled with water cress, through which the cold water trickled, and was hidden in the dense shadow of a thick growth of trees. The larvae were obtained only beneath the water cress, in the thin layer of soft mud overlying the rocky substratum. One larva was found, apparently preparing for transformation, occupying a little excavation among the roots of a layer of wet moss, in a crevice of a rock above the level of the water. This specimen was taken home for rearing, but was afterward lost; I do not know anything about the other stages of this insect. The form of its respiratory disk is very different from that of *Epiphragma* just described, but, aside from that, it is more like *Epiphragma* in form of body and prolegs and in mouth parts than any other Tipulid larva known to me, and I think it will be found to belong to some species of larger size belonging near *Epiphragma* in the series.

Since my study of this larva Dr James Fletcher, of Ottawa Can., has sent me a specimen of it from his home. He says it is found "from time to time in water brought from a spring through wooden pipes, and used for drinking." It may prove a constant inhabitant of cold spring water.

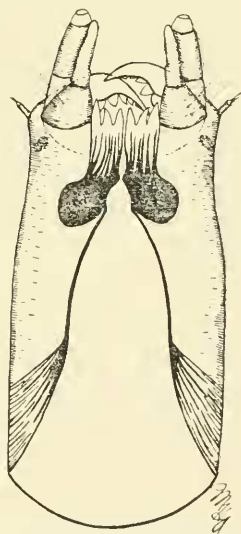


Fig. 19 Ventral aspect of head and mouth parts of unknown tipulid larva described herewith

**Larva.** Length 42mm; greatest diameter of thorax 5mm; of abdomen 7mm. Body cylindric, smooth, white translucent, with unusually abrupt narrowing at the anterior end to the wholly retractile head (fig.19). Seventh abdominal segment inflated. No surface hairs or spines; but on the ventral side of the three thoracic segments are three pairs of spine-tipped structures which I take to be the rudiments of the thoracic legs.

There are stout, brownish prolegs on abdominal segments 4-7, paired and separate on 4, becoming completely fused on succeeding segments into a transverse ridge, each proleg capped with a mere obtuse hillock of chitin, bearing no hooks or spines. Abdomen strongly tapering beyond the inflated seventh segment. Spiracles black, seated on a narrow and imperfect respiratory disk [pl.10, fig.5], whose dorsal margin is indicated only by a slight ridge, and from whose ventral side arise two long processes, approximated at base, tapering, slightly granulate before the tip, and with about six to eight minute, fragile, unequal hairs on the obtuse apex. Anal aperture surrounded by four equal, taper, pointed, white appendages, each showing a tendency to the formation of a telescopic joint at two thirds its length.

#### An unknown Leptid larva from rapid streams

On plate 10, figure 1 we show a curious larva that seems clearly to belong to the family Leptidae, but that differs considerably in structure from the Leptid larvae hitherto made known. I first collected small specimens from the rapids in Six Mile creek at Ithaca in December 1896. During the summer of 1901 larger larvae were frequently found in Fall creek. They live in the crevices of the stones in rushing waters, associated with stone fly and caddis fly larvae. But few specimens were obtained, and no attempt was made to rear them. Two species of *Chrysopila*, (*C. ornata* and *C. thoracica*), are common at Ithaca, and this larva may belong to one of these.

**Larva.** Length 16mm; caudal filaments (arising from the ventral border of the respiratory disk) 3mm additional; diameter 2mm.

Color dark greenish; skin subrugose, somewhat shining. Body nearly cylindric, slightly thickest on the sixth abdominal segment, with strongly tapering metathorax and mesothorax, slender and attenuate prothorax and strongly retractile head. The median ridge of the head is very prominent in front, shaped like an inverted sled runner. Antennae prominent, slender, two jointed. Mandibles ending in strong, ventrally directed



hooks. A ventral pair of slender bristles under both mesothorax and metathorax.

There are stout ventral prolegs on abdominal segments 1-8, paired on all the segments except the eighth, each with a double circlet of hooks at its tip. On segment 1 each proleg is simple, with hooks directed posteriorly. On segments 2-7 each proleg is divided at its apex, becoming double, with the hooks on its two divisions opposed in position [pl.10, fig.2]. On the eighth segment there is a single median proleg with its hooks directed forward, and at its base is a pair of low, broad anal tubercles. There are two pairs of conic, fleshy tubercles on each of segments 1-7 of the abdomen, one tubercle at either side of the dorsum and a longer one at the middle of each side, all increasing in length posteriorly. The abdomen ends on the dorsal side in a pair of long, fleshy processes, stout at base and attenuate to apex, each with a lateral fringe of long hairs each side, on the outer side the fringe extending on segment 8 nearly to its base. Between the bases of these processes on the dorsum of the eighth segment is the single respiratory aperture—a narrow median slit guarded by white lips, on a low convex elevation.

The most remarkable features of this larva are (1) the conformation of the caudal end of the abdomen, (2) the single respiratory aperture and (3) the paired and bifurcated prolegs with their heavy armature of grappling hooks. This grappling apparatus is doubtless correlated with a life spent clinging to the surfaces of rocks in the current of rushing streams.

#### A note on caddis flies described in Bulletin 47

The identity of the species described on p.569-70 as "*3 Halesus* sp.?" has been settled by the rearing of it by Mr Betten at Lake Forest Ill. It is *Halesus hostis* Hagen. Larvae, in cases like the one shown in plate 33, figure 1 of Bulletin 47, were collected from a spring-fed rivulet late in August. Pupae were found in the breeding cage soon thereafter, and a fine male imago emerged on Sep. 23.

Two excellent German students of the Trichoptera, Ulmer and Weltner, simultaneously and very kindly sent information as to the probable identity of the "egg-ring of an unknown caddis fly" figured on plate 33 of Bulletin 47. Similar egg masses are laid, they say, by the European species *Phryganea grandis* and *Phryganea striata*, and this one may well have belonged to our *Phryganea cinerea* Hagen.